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## EARLY SURVIVAL AND GROWTH OF PLANTED NORTHERN RED OAK IN THE SOUTHERN APPALACHIANS

Abstract. --This paper presents 2-year survival and growth data for six northern red oak plantings, each containing three morphological seedling grades, over a range of site indexes from 76 to 98 feet at age 50.

Seedling survival averaged 94 percent, with no important differences due to seedling grade or site index. Height growth has averaged only 3 inches a year. There has been no significant growth difference between grades, but seedlings on site 76 land grew less than those on the five sites with higher site index.

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Northern red oak is one of the most valuable Southern Appalachian hardwoods because of its rapid growth and high quality. Unfortunately, regeneration of northern red oak, either natural or artificial, is difficult. Erratic seed supply and high seedling mortality make natural reproduction unreliable, and seed predators preclude successful direct seeding at reasonable cost.

Planting northern red oak seedlings offers one possibility for regenerating this species. A study was set up to investigate the survival and growth of seedlings on a wide range of sites. Results of the first 2 years in the field are now available.

The seedlings for the study were grown in the Bent Creek Experimental Forest nursery from local seed. They were lifted in the spring of 1965 and sorted by diameter of root collar into grade 1 (more than 9/32 of an inch), grade 2 (between 7/32 and 9/32 of an inch), and grade 3 (between 5/32 and 7/32 of an inch). Roots were pruned to a length of 8 inches.

Six plots were selected, and the site index of each was determined on the basis of the height and age of the northern red oak then growing on the plot. These site indexes ranged from 76 to 98 at age 50, a range which includes most of the commercially important northern red oak sites in the region.

In the summer of 1964 the plots were cleared of all trees and brush, and all foliage was sprayed with 2,4,5-T in oil. In March 1965 three replicates of each grade of seedling were bar planted on each selected plot at 5-foot intervals in rows 5 feet apart. Each year since planting the plots have been cleaned to remove competition, and the planted seedlings have been sprayed with a deer repellent.

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After 2 years in the field, the rate of survival was uniformly high (table 1). There were no significant differences among seedling grades. Predictably, the survival rate was lowest on the site with the lowest index (76); however, even this mean rate of survival (85 percent) was adequate to establish new stands.

Table 1. --Survival by seedling grade and site index after 2 years

Plot	Site index	Survival			
		Seedling grade			Mean
		1	2	3	
----- <u>Percent</u> -----					
1	76	83	90	83	85
2	81	98	100	97	98
3	85	100	98	100	99
4	91	97	100	95	97
5	93	92	98	93	94
6	98	95	92	87	91
Mean		94	96	92	94

After 1 year in the nursery and 2 years in the field, height growth has been rather slow (table 2). There was a highly significant difference in planted heights: grade 1 seedlings were three times as tall as those in grade 3, and grade 2 seedlings were intermediate in height. The growth pattern shows that seedlings in grades 2 and 3 have grown more rapidly in the field than have grade 1 seedlings, but grade 1 seedlings still show a significant height superiority over those in the other grades. This superiority is due entirely to more rapid growth in the nursery beds. If present trends of height growth continue, the effect of seedling grade will not be noticeable after a few years.

Height growth was very poor on the site with index 76, especially among seedlings in grades 1 and 2. There were no significant differences in height growth on the other five sites. The low survival and 2-year height growth on the site with index 76 indicate that this index value may be too low for northern red oak.

There was a considerable amount of top kill and subsequent sprouting throughout the plots. Top kill was most common in grade 1 and 2 seedlings. Several agents were responsible for this top kill, including deer, rabbits, mice, and frost. Much of the loss, however, was due to dieback of seedlings for no obvious reason. In some instances, the subsequent sprouts grew very rapidly and exceeded the growth of the unaffected seedlings.

Table 2. --Planted height and 2-year height growth by seedling grade and site index

Plot	Site index	Planted height				2-year height growth			
		Grade 1	Grade 2	Grade 3	Mean	Grade 1	Grade 2	Grade 3	Mean
----- Feet -----									
1	76	1.64	1.06	0.58	1.09	0	0.08	0.37	0.15
2	81	1.59	1.02	0.59	1.07	0.54	0.61	0.65	0.60
3	85	1.75	0.94	0.60	1.10	0.50	0.61	0.52	0.54
4	91	1.71	0.90	0.60	1.07	0.37	0.47	0.39	0.41
5	93	1.87	1.01	0.60	1.16	0.43	0.59	0.57	0.53
6	98	2.05	1.01	0.58	1.21	0.37	0.71	0.81	0.63
Mean		1.77	0.99	0.59	1.12	0.37	0.51	0.55	0.48

It is too early to draw final conclusions about the success or failure of these plantations. Survival is excellent but height growth has averaged only 3 inches a year in the field. The planted oak must attain a height growth of about 2 feet per year for the first 20 years if it is to compete with natural stands.<sup>1</sup>

<sup>1</sup>Olson, David F., Jr. Site index curves for upland oak in the southeast. U. S. Forest Serv. Southeast. Forest Exp. Sta. Res. Notes 125, 2 pp. 1959.

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